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becoming replaced by metals in the state in which they are observed in the laboratory, when the most powerful jar spark is employed. At a lower temperature, the gases disappear almost entirely, and the metals occur in the state produced by the electric arc. These changes are simply and sufficiently explained on the hypothesis of dissociation.

The final chapter on the birth and death of worlds is based on Arrhenius's book entitled "Worlds in the Making." Arrhenius takes up the questions of the creation and of the eventual destruction of the stars and of worlds like our own, and gives reasons for believing that both operations are simultaneously occurring in cosmos, or, so to speak, a "winding up" and a "running down" of the machinery of the universe; the two chief forces at work being the mechanical pressure of light, or simply the "radiation pressure," on the one hand, and gravitation on the other.

WILDER D. BANCROFT

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PROPOSED INTERNATIONAL MAGNETIC  
AND ALLIED OBSERVATIONS DURING  
THE TOTAL SOLAR ECLIPSE  
OF AUGUST 21, 1914 (CIVIL  
DATE)

In response to an appeal for simultaneous magnetic and allied observations during the coming total solar eclipse, cooperative work will be conducted at stations along the belt of totality in various countries and also at some outside stations.

The general scheme of work proposed by the Carnegie Department of Terrestrial Magnetism embraces the following:

1. Simultaneous magnetic observations of any or all of the elements according to the instruments at the observer's disposal, every minute from August 21, 1914, 10<sup>h</sup> A.M. to 3<sup>h</sup> P.M. Greenwich civil mean time, or from August 20, 22<sup>h</sup> to August 21, 3<sup>h</sup> Greenwich astronomical mean time.

(To insure the highest degree of accuracy, the observer should begin work early enough to have everything in complete readiness in proper time. See precautions taken in previous eclipse work as described in the journal

*Terrestrial Magnetism*, Vol. V., page 146, and Vol. VII., page 16. *Past experience has shown it to be essential that the same observer make the readings throughout the entire interval.*)

2. At magnetic observatories, all necessary precautions should be taken to insure that the self-recording instruments will be in good operation not only during the proposed interval but also for some time before and after, and eye-readings should be taken in addition wherever it is possible and convenient. (*It is recommended that, in general, the magnetograph be run on the usual speed throughout the interval, and that, if a change in recording speed be made, every precaution possible be taken to guard against instrumental changes likely to affect the continuity of the base line.*)

3. Atmospheric-electric observations should be made to the extent possible with the observer's equipment and personnel at his disposal.

4. Meteorological observations in accordance with the observer's equipment should be made at convenient periods (as short as possible) throughout the interval. It is suggested that, at least, temperature be read every fifth minute (directly after the magnetic reading for that minute).

5. Observers in the belt of totality are requested to take the magnetic reading every thirty seconds during the interval, 10 minutes before and 10 minutes after the time of totality, and to read temperature also every thirty seconds, between the magnetic readings.

It is hoped that full reports will be forwarded as soon as possible for publication in the journal of *Terrestrial Magnetism and Atmospheric Electricity*.

L. A. BAUER

WASHINGTON,  
June 23, 1914

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SPECIAL ARTICLES

AMMONIFYING POWER OF SOIL-INHABITING FUNGI

A COMPARATIVELY large amount of work has been done on the power of soil bacteria to produce ammonia from the nitrogenous materials found in the soil, or from organic materials such as dried blood or cotton seed meal added

to the soil. A comparatively small amount of work has been done on the power of soil-inhabiting fungi to produce ammonia under like conditions. Müntz and Coudon<sup>1</sup> demonstrated that the production of ammonia from the organic matter in soils is a property common both to molds and to bacteria. It is interesting to note that they used both bouillon and one hundred gram portions of soil, with manure added as culture media. In their investigations they used two pure cultures of molds, *Mucor racemosus* and *Fusarium Muentzii*. Later Marchal<sup>2</sup> confirmed their results.

In a series of investigations which were carried on for the purpose of determining the effect of acid phosphate on the ammonification of dried blood in soils, we observed that with varying percentages of acid phosphate the amount of ammonia accumulated in one particular type of soil increased with the increase of acid phosphate from 0.25 per cent. to 2 per cent. There was but a slight decrease of ammonia in the soil receiving 5 per cent. of acid phosphate. In fact, there was over one half more ammonia accumulated in the soil containing 5 per cent. of acid phosphate than in the soil to which no acid phosphate had been added. It was also observed that there was a very heavy growth of molds on all soil portions receiving acid phosphate. Counts were made of bacteria in the soil portions, and it was found that there was a decrease from 240,000,000 bacteria per gram of soil in the portions containing 0.5 per cent. of acid phosphate to 12,200,000 in the soil portions receiving 5 per cent. of acid phosphate. The opposite effect was noted in using certain other soils. There was no appreciable growth of molds in these soils, and the amount of ammonia accumulation decreased with increased quantities of acid phosphate. This was exactly the opposite of what was to be expected as several investigators have held that molds use ammonia for the development of their mycelium. From these results we were led to conclude that there was either a modification in the character or number of ammo-

nifying bacteria present, or that it was due to the ammonifying power of the large number of fungi present in this soil and that this activity was stimulated by the addition of a large quantity of acid phosphate.

Several plates which showed a considerable number of mold colonies were set aside to allow further development. Various fungi were separated into pure cultures. Of these the commonest were *Zygorhynchus Vuilleminii*, *Rhizopus nigricans*, and certain species of *Penicillium*. To guard against possible contamination of the plates by spores from the air, these fungi were reinoculated into the soil from which they were isolated. Their growth in this medium determines their status as soil-inhabiting fungi. The fungi so secured include, in addition to those already named, species of *Alternaria*, *Aspergillus* and *Trichoderma* and several species of *Mucor*. One other species, *Monilia sitophila*, was isolated from soils, which had been heated to a high temperature in the autoclave.

As the decomposition of the nitrogenous materials in soils is influenced to a certain extent by their chemical and physical composition and by their reaction, two soil types were used; one of these was a gravelly loam acid soil, the other a red shale neutral soil. Identical methods were used in the ammonification studies. One hundred gram quantities of sterile soil were used. The "beaker method"<sup>3</sup> was employed. Dried blood and cotton seed meal were used as sources of nitrogen, amounts of these containing 155 mgs. of nitrogen were used in each case. The cultures were incubated at 20° C. for seven days, and the ammonia determined.

There was found to be a considerable difference in the power of the various soil fungi studied to ammonify dried blood and cotton seed meal in the soil; that is, in their ammonifying efficiency. A comparison of all of these fungi was made in the loam soil, using dried blood as a source of nitrogen. In all cases but one the addition of two grams of acid phosphate increased the ammonifying effi-

<sup>1</sup> *Compt. Rend. Acad. Sci., Paris*, 116: 395. 1893.

<sup>2</sup> *Bull. Acad. Roy. Belgique*, III., 25: 727. 1893.

<sup>3</sup> N. J. Experiment Station Report, 1908: 129.

ency. It is interesting to note that with a single exception there was an increased growth of mycelium, with increased ammonia accumulation. In the case of *Zygorhynchus*, there was but a slight growth of mycelium, although a fairly large amount of ammonia was accumulated in the soil. Of the cultures studied, *Trichoderma* showed the largest ammonifying efficiency, which was 48.52 per cent. in soil not containing acid phosphate, and 58.39 per cent. in soil containing 2 per cent. of acid phosphate. On the other hand, *Penicillium I.* showed an ammonifying efficiency of 21.39 per cent. in soil containing no acid phosphate, and 16.45 per cent. in soil containing 2 per cent. of acid phosphate. *Penicillium VI.* showed a very low ammonifying efficiency, which was 10.75 per cent. without acid phosphate, and 12.15 per cent. with 2 per cent. acid phosphate added. A comparison was made of the ammonification of dried blood and cotton-seed meal in the two different soils, inoculating them with *Penicillium VII.* and *Rhizopus nigricans*. More ammonia was accumulated in each soil from cotton-seed meal than from dried blood in the case of both fungi.

The addition of calcium carbonate appeared to inhibit the ammonification of dried blood in the red shale soil with *Rhizopus* and *Penicillium VII.*, but the addition of even small amounts of acid phosphate increased the ammonia accumulation. From some of the results obtained, it appears that the presence of soluble phosphates in the soil, rather than its reaction, determines the amount of ammonia accumulation.

In comparing the ammonifying power of soil bacteria with that of soil fungi using dried blood in the loam soils, the highest amount of ammonia accumulated in the case of the bacteria was with *Bacillus subtilis*, which showed 54.13 milligrams of ammonia nitrogen in the portion not containing acid phosphate and 17.55 milligrams in the portion containing 2 per cent. acid phosphate. In the case of fungi, the highest amount of ammonia accumulated was by *Trichoderma* which showed 75.20 milligrams ammonia nitrogen in the

portion not containing acid phosphate and 90.50 milligrams of ammonia nitrogen in the portion containing acid phosphate.

A more detailed account of these fungi and of the data accumulated by us concerning them will be published at an early date.

HARRY C. McLEAN,  
GUY WEST WILSON

N. J. AGRICULTURAL EXPERIMENT STATION,  
NEW BRUNSWICK, N. J.

#### THE IOWA ACADEMY OF SCIENCE

THE meetings of the twenty-eighth annual session of the Iowa Academy of Science were held at Iowa State Teachers College, Cedar Falls, beginning Friday afternoon, April 24, and closing at noon Saturday, the 25th. The meeting was called to order at 1:30 P.M. by the president, Professor C. N. Kinney, of Drake University. After the preliminary business was transacted the academy proceeded to the reading of papers until adjournment to meet at 9:00 A.M. Saturday.

The evening address was given by Dr. N. H. Winchell, of the Minnesota Historical Society, on "The Antiquity of Man in North America in Comparison with Europe."

Following the reading of papers and the final business meeting a luncheon was served in the gymnasium at noon, Saturday.

As officers for the ensuing year the following elections were made:

*President*, H. S. Conard, Grinnell.  
*First Vice-president*, H. M. Kelly, Mount Vernon.  
*Second Vice-president*, L. S. Ross, Des Moines.  
*Secretary*, James H. Lees, Des Moines.  
*Treasurer*, A. O. Thomas, Iowa City.

It was decided to try the plan at the next annual meeting, to be held at the State University of Iowa, Iowa City, of carrying out the program in two divisions: a general session and sectional meetings.

It was also recommended that the state legislature be urged to appropriate additional funds to enable the Geological Survey to complete the topographic map of the state in the least possible time.

#### Program

(Abstracts by the authors.)

*Sulfonation in Soils*: P. E. BROWN AND E. H. KELLOGG.

*The Des Moines Diphtheria Epidemic of 1912-13*: CHAS. A. WYLIE.